Historical Sedimentation Rate Determinations in Lake Erie

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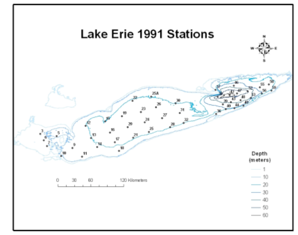
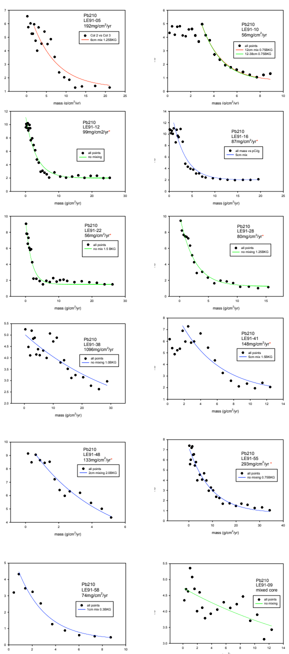
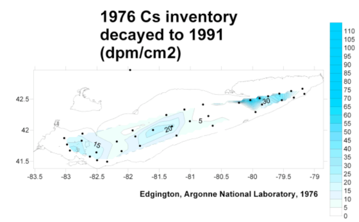
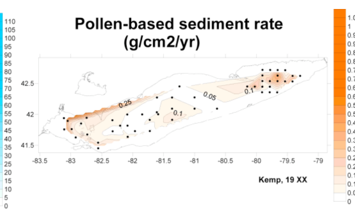


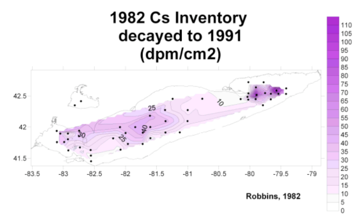
Estimates of sedimentation rates in Lake Erie are available from several historical data sets. The most complete set of cores for determining long-term permanent mass accumulation rates using ^{210}Pb and ^{137}Cs geochronologies were collected as part of a research cruise carried out in Lake Erie in 1991 aboard the R/V Neeskay. These data have been reexamined and archived samples analyzed to establish sedimentation rates at approximately 40 stations during the early part of the zebra mussel colonization of Lake Erie (Figure 1).

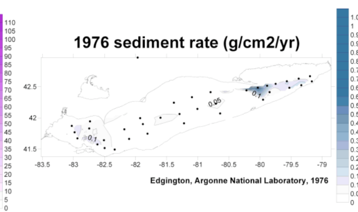


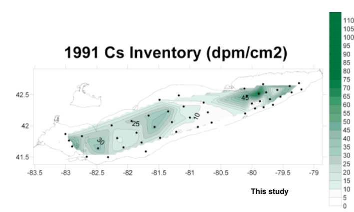
Lake Erie 1991				
Station	**sed rate (g/cm2/yr)**	*Cs and Pb congruance	Cs Inventory (pCi/cm2)	Pb Inventory (pCi/cm2)
25A	n/a		n/a	n/a
3	0.317		6.14	49.53
5	0.192		12.11	54.60
6	mixed		21.81	2.37
7	0.307	*	18.85	47.40
9	mixed		16.75	50.12
10	0.056		7.94	57.95
11	0.316		11.16	68.99
12	0.099	*	10.10	78.11
13	0.056	*	6.22	29.33
14	0.102		6.99	35.18
15	n/a		n/a	n/a
16	0.087	*	8.02	74.10
17	0.085	*	9.94	69.05
18	n/a		n/a	n/a
19	0.077		14.45	48.63
20	0.137		17.06	98.99
21	0.098	*	7.59	31.43
22	0.056	*	4.39	56.31
23	0.106	*	13.34	67.55
24	0.101	*	9.70	41.04
25	0.058		1.51	57.50
26	0.066	*	4.51	36.71
27	0.126	*	6.25	51.29
28	0.080	*	2.88	38.26
30	0.118	*	4.16	29.56
31	n/a		n/a	n/a
32	n/a		n/a	n/a
36	0.703	*	25.03	104.54
37	0.472	*	8.91	44.19
38	1.096		24.65	103.44
39	0.124	*	0.37	30.42
40	n/a		n/a	n/a
41	0.148	*	5.36	48.71
42	0.591	*	36.49	94.66
43	0.018	*	0.78	34.18
44	mixed		8.13	20.74
46	0.177	*	18.79	85.42
47	0.542-0.736		16.39	70.52
48	0.133	*	15.86	33.57
49	n/a		n/a	n/a
52	0.728-0.955		3.08	20.30
53			22.45	47.19
55	0.293	*	21.48	83.49
56	0.086	*	8.44	76.82
58	0.074		15.04	13.18
59	n/a		n/a	n/a

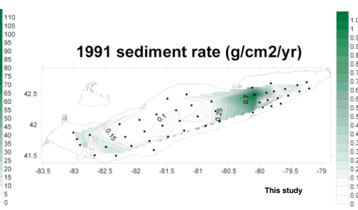












Methods: Sediments were collected using a geochemical box core (30 cm x 30 cm x 100 cm) aboard the R/V Neeskay in June 1991. Cores were sub-sampled pneumatically into 7.5 cm diameter plastic core tubes. These cores were extruded hydraulically into into 1 cm, 2 cm or 4 cm sub-samples into tared plastic jars. Subsections were then weighed, dried at 60 C. and reweighed to determine percent water content. Porosities were determined from water content assuming a dry sediment density of 2.3 g $cm^{-3}{}_{dry\ sed}$. Pb-210 activities were determined following a modification of the procedure of Robbins and Edgington (1975).

Cesium 137 (^{137}Cs) counts were taken by direct measurement of the ground sediment sample prior to digestion for ^{210}Pb using a calibrated sodium iodide (NaI) detector. The ^{210}Pb data and ^{137}Cs data were graphed against cumulative mass. Cores were plotted using the natural log of the excess ^{210}Pb and the mass of each layer interval. Sediment rates were calculated using the slope of the resulting curve.

Results: ^{210}Pb profiles are shown above for the typical range in fits to the data observed for these ~40 stations in 1991. Many profiles exhibit relatively tight, coherent exponential decay geochronologies (e.g. Stations 28 and 55), while others show considerable scatter. At some stations, extensive mixing prohibits assigning a chronology to the data. Cores in which the ^{137}Cs data is consistent with the ^{210}Pb chronology, as determined by the depth of the appearance of ^{137}Cs (1954) agreeing with the ^{210}Pb age are indicated by an * in the above table. Sedimentation rates were able to be estimated at 35 of these stations and the rates vary from <20 mg cm^{-2} y^{-1} to >1000 mg cm^{-2} y^{-1} (Table 1) with an average of 230 mg cm^{-2} y^{-1}.

In addition to the 1991 data set presented here, there are 3 other data sets which contain extensive coverage of the Lake Erie basin. These include: ^{210}Pb determined sedimentation rates conducted by Edgington and co-workers in 1976, ^{137}Cs inventories measured by Robbins (NOAA GLERL) in 1982, and a data set consisting of cores in which the ambrosia pollen horizon was used to determine net mean mass accumulation conducted by Kemp (data from B. Eadie). Shown above are the areal distribution of sedimentation rates (g cm^{-2} y^{-1}) derived from these data sets (plots on the right), as well as the areal distribution of ^{137}Cs inventories measured in 1976, 1982 and 1991 (all decay corrected to 1991, ½ life ^{137}Cs = 30 yrs, shown on the left).

The average ^{137}Cs inventory measured by Robbins in 1982 was 30.8 dpm cm^{-2}, which is equivalent in 1991 to 25.0 dpm cm^{-2} - in excellent agreement with the average inventory measured in 1991 of 25.12 dpm cm^{-2}. Both the sedimentation rates and the ^{137}Cs inventories collected in 1976 are less than those measured subsequently. At present we have no explanation for this difference.

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